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Bezeichnung der Erfindung/Title of the invention/Titre de l'invention:
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If no title is shown please refer to the description.
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Optical disc and apparatus for portable applications

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DESCRIPTION

Field of the invention

The invention relates to an optical disc and to an optical recording and/or reproducing apparatus for recording and/or reproducing said optical disc.

The invention is especially useful for portable applications where optical discs with reduced dimensions like Small Form Factor Optical (SFFO) discs are required.

Domain of the invention

A number of disc-shaped optical storage media have been developed for use in storing various types of digital data in a manner such that the optical disc can be readily removed from the read/write drive for which it is designed. Common current examples include the Compact Disc (CD) and the Digital Versatile Disc (DVD). Although these examples have been highly successful for particular applications such as storing data for use on a Personal Computer (PC), or storing music or other audio or video information such as motion pictures, these devices have proved less useful in applications where an optical storage medium with a smaller size is preferable. One class of such applications includes various Personal Electronic Devices (PEDs). Personal electronic devices in general have a size, shape and weight such that it is feasible and convenient to carry such devices on a person. Examples of personal electronic devices include digital cameras, cellular telephones, personal digital assistants and the like.

An optical disc having a more compact design and a larger storage capacity is described in the European patent application EP 1 067 519 A1. As shown in Fig. 1, said optical disc consists of a substrate 1 made of polycarbonate resin, which has a thickness Th_1 of 0.6 mm. The substrate comprises a center hole 2. Around said center hole, said substrate comprises an annular table abutment 3 having a thickness Th_2 equal to Th_1. The table abutment 3 is to be placed on a turntable 4 of a rotation driving mechanism in an optical recording and/or reproducing apparatus in which the optical disc is set. There is provided at the center of the substrate 1 a magnetic clamping hub 5 so as to close the center hole 2. The hub 5 is made of a thin plate of magnetic metal such as iron.

Said optical disc is set on a rotation driving mechanism of an optical recording and/or reproducing apparatus. The rotation driving mechanism consists of a spindle motor 8, a spindle 7 driven by said spindle motor and the turntable 4 fixed at an end of said spindle. An annular magnet 6 is fixed on the turntable 4. The hub 5 of the optical disc is attracted by the magnet 6 and is thus securely held on the turntable 4 and can be rotated along with the turntable 4. It is to be noted that the shapes of the hub 5, the turntable 4 and the table abutment 3 have been designed such that, when the optical disc is placed on

the turntable, the hub is in vicinity of, but not in contact with the annular magnet 6. This prevents from any excessive attractive force to act on the hub and consequently the optical disc can be easily removed from the turntable.

A drawback of such an optical disc is that it requires a hub for being clamped to the turntable of an optical recording and/or reproducing apparatus. Said hub has to be fixed to the optical disc, which raises some difficulties in the production process of the optical disc and causes the thickness of said optical disc to be too high for portable applications.

Summary of the invention

An object of the invention is to propose an optical disc, which is easier to implement, in particular for portable applications.

To this end, an optical disc according to the invention comprises a magnetic substrate.

With the invention, no hub is required, because the substrate, by virtue of its magnetic properties, is able to clamp the optical disc onto a turntable of a rotation driving mechanism in an optical recording and/or reproducing apparatus.

Fixing a hub to an optical disc requires special aligning equipment and thus is an extra source of tolerance errors in the production process of said optical disc. An advantage of getting rid of a hub is therefore to simplify the manufacturing of said optical discs and to make it more reliable.

According to the prior art, a hub introduces an additional thickness, which is at least equal to the table abutment needed to maintain the hub in place on the optical disc. With a magnetic substrate, no table abutment is required. Another advantage of having no hub is therefore to reduce the thickness of said optical disc, which is of great interest for portable applications.

Such a magnetic substrate is preferably made of soft magnetic material for two main reasons: firstly, it is generally cheaper than a hard magnetic material; secondly, it does not attract other magnetic material after removal of the optical disc out of the optical recording and/or reproducing apparatus.

Using a metallic substrate may help to significantly reduce the overall disc thickness with respect to an optical disc with a polycarbonate substrate. As a matter of fact, the manufacturing of thin polycarbonate substrates may cause some problems related to injection molding technology and polycarbonate rigidity. On the contrary, a metallic substrate, even it has been designed extremely thin, does not raise particular difficulties for manufacturing and keeps a rigidity, which protects the optical disc against bending.

Therefore, in a preferred embodiment of the invention, said magnetic substrate is made of soft magnetic metal, for instance iron.

Another advantage of such a metallic substrate is that it gives a higher inertia to the optical medium, which contributes to avoid speed variation of the spindle motor. It should be noted that even a small speed variation might induce dramatic errors during writing.

Such a metallic substrate is also less sensitive to humidity and temperature variations, which are responsible of tilt problems with polycarbonate substrates.

The present invention also relates to an apparatus for recording and/or reproducing such an optical disc.

These and other aspects of the invention will be apparent from and will be elucidated with reference to the embodiments described hereinafter.

Brief description of the drawings

The invention will be further described with reference to the accompanying drawings:

- Fig. 1 depicts an optical disc set onto a turntable of a recording and/or reproducing apparatus according to the background art,
- Fig. 2a to 2c depict optical discs according to the invention,
- Fig. 3 shows how an optical disc is placed and clamped onto the turntable of an optical recording and/or reproducing apparatus according to a first embodiment of the invention,
- Fig. 4 shows how an optical disc is placed and clamped onto the turntable of an optical recording and/or reproducing apparatus according to a second embodiment of the invention,
- Fig. 5 shows how an optical disc is placed and clamped onto the turntable of an optical recording and/or reproducing apparatus according to a third embodiment of the invention,
- Fig. 6 shows how an optical disc is placed and clamped onto the turntable of an optical recording and/or reproducing apparatus according to a fourth embodiment of the invention,
- Fig. 7 depicts a manufacturing process of the information layer of a pre-recorded optical disk according to the invention.

Detailed description of the invention

An optical disc usually comprises a base layer, called a substrate, for supporting an information layer and a cover layer. Said information layer is intended to contain information to be stored in said optical disc and said cover layer aims at protecting said information layer, in particular from dust.

An optical disc according to the invention comprises a magnetic substrate. Three examples of such an optical disc are depicted in Figs. 2a, 2b and 2c:

- Fig. 2a shows a planar optical disc with a planar magnetic substrate 10. Said optical disc also comprises an information layer 11 and a cover layer 12,
- Fig. 2b shows a planar optical disc according to the invention, whose substrate 20 comprises a hollowing-out for receiving an information layer 21 and a cover layer 22,
- Fig. 2c shows a non-planar optical disc according to the invention, comprising a planar magnetic substrate 30, an information layer 31 and a cover layer 32, such that said substrate 30 overlaps said information and said cover layers.

An optical disc according to the invention may be a pre-recorded or read-only (ROM) optical disc or a recordable or write-once (WO) optical disc or a rewritable (RW) optical disc or a combination of these types (for instance, read-only combined with recordable). It may also consist of multiple information layers like for instance, dual-layer discs do.

It is to be noted that the information layer (11, 21, 31) has a thickness that is typically in the range of 5 to 100 nm for a pre-recorded optical disc and a thickness typically in the range of 50 to 250 nm for a recordable or a rewritable optical disc. The cover layer (12, 22, 32) is for instance made of polycarbonate and has a typical thickness of 100 μm.

Said optical disc is for instance a Small Form Factor Optical (SFFO) disc, but it is not limitative. In this case, said optical disc has a diameter of about 30 mm.

Said substrate does not need to be a permanent magnet, that is a hard magnetic material. On the contrary, it may advantageously be made of soft magnetic material, which means a material that can be easily magnetized in the presence of a magnetic field, but whose magnetization is not permanent if the magnetic field is removed. Soft magnetic materials comprise metals and their alloys, but also polycarbonate with magnetic particles or soft magnetic ferrites, called ceramic-like materials like plastic bonded ferrites.

In a preferred embodiment of the invention, said substrate is made of soft magnetic metal like for instance iron. As a matter of fact, an advantage of a metallic substrate is that it has a five times higher specific stiffness than a polymer substrate. The use of metal therefore enables a substantial reduction of the substrate thickness, which is of great interest for portable applications. It is therefore possible to manufacture a metallic substrate having a thickness equal to 100 μm, which is not the case for instance with polycarbonate substrates.

The magnetic properties of the substrate (10, 20, 30) are used for magnetically clamping the optical disc according to the invention onto a turntable of an optical recording

and/or reproducing apparatus. Some ways in which the optical disc may be placed and fixed onto the turntable are depicted in Figs. 3 to 6.

Said optical recording and/or reproducing apparatus comprises rotating means 40 for rotating a turntable 50 and optical means 60 for recording and/or reproducing the optical disc 35. Said turntable 50 is driven by said rotating means 40 through a spindle 41. Said optical means 60 comprise an objective lens 61 and a laser beam 62. Said turntable 50 comprises magnetic means 51, which have for instance an annular shape for attracting the magnetic substrate (10, 20, 30) of the optical disc onto said turntable 50, in order to maintain the optical disc in place during a rotation of the turntable.

Said turntable 50 further comprises heightening means 52 for preventing said optical disc from getting in contact with said magnetic means 51. Said heightening means 52 heighten the optical disc so as to leave an air gap 53 of about 0.05 mm between said turntable 50 and said optical disc. In this way, no excessive attractive force is applied on the optical disc, which can be easily removed from the turntable 50. In a preferred embodiment of the invention, said heightening means 52 are achieved by an annular protuberance, which is intended to support the optical disc.

An optical disc is usually read through the substrate, which is in general made of a light-transparent material, so as to let a laser beam read said information through said substrate. On the contrary, an optical disc according to the invention cannot be read through its magnetic substrate by the optical means 60, because a laser beam cannot go through a magnetic material. Therefore, said optical disc must be read through the cover layer (12, 22, 32) and said cover layer has to be made of a material, which is transparent for said laser beam, for instance a polycarbonate.

In a first embodiment of the invention, described in Fig. 3, a planar optical disc 35 with a planar magnetic substrate 10 and depicted in Fig. 2a is involved. Said optical disc has therefore a substrate face and a cover layer face. The rotating means 40 of the optical recording and/or reproducing apparatus are put on said substrate face, so as to let the substrate achieve its hub function, whereas the optical means 60 are put on the cover layer face, so as to make recording and/or reproducing of the optical disc possible. It is to be noted that the laser beam 62 is focused on the information layer 11 using the optical lens 61 and said cover layer. An advantage of said solution is to use a thin planar optical disc 35, which is very easy to manufacture.

In a second embodiment of the invention, depicted by Fig. 4, the same optical disc 35, depicted in Fig. 2a, is placed into a recording and/or reproducing apparatus, wherein said rotating means 40 and said optical means 60 are put on a same side of said optical disc, that is on the transparent cover layer side. The turntable 50, which is driven by said rotating means 40, and the magnetic means 51 are thus placed on the cover layer side. In

other words, the optical disc 35 has to be turned over compared with the previous embodiment. Consequently said magnetic means are no more in the closest vicinity of the magnetic substrate 10. However, the magnetic means 51 may have a magnetic field with a sufficient intensity to attract the magnetic substrate 10 through the information layer 11 and the cover layer 12. A first advantage of said embodiment is, as in the previous embodiment, that the optical disc 35 involved comprises planar layers and is consequently very easy to manufacture. A second advantage is that the total thickness of the recording and/or reproducing apparatus is reduced.

In a third embodiment of the invention, depicted by Fig. 5, the optical disc 36, depicted in Fig. 2b, is placed into a recording and/or reproducing apparatus, wherein said rotating means 40 and said optical means 60 are put on a same side of said optical disc. Said optical disc 36 is still planar but the magnetic substrate 20 of said optical disc 36 comprises a hollowing-out for receiving an information layer 21 and a cover layer 22, so as to uncover a part of the magnetic substrate 20. Since said magnetic substrate 20 is visible on both sides of the optical disc 36, said magnetic substrate 20 is able to optimally achieve its hub function.

In a fourth embodiment of the invention, depicted by Fig. 6, the optical disc 37, shown in Fig. 2c, is placed into a recording and/or reproducing apparatus, wherein said rotating means 40 and said optical means 60 are put on a same side of said optical disc. Said optical disc 37 comprises a planar magnetic substrate, which overlaps the information layer 31 and the cover layer 32, so as to let space left for the magneting means 51. Said optical disc 37 therefore comprises an area where the magnetic substrate 30 is present on its both sides and with a thickness reduced to the thickness of said magnetic substrate. Said substrate 30 is therefore able to optimally achieve its clamping function. Provided that the magnetic means 51 are designed to fit into the space left in the center hole of the optical disc, a reduction of the total thickness of the optical recording and/or reading apparatus may be obtained. Said reduction is equal to the summation of the thickness of the information and cover layers.

The way in which an optical disc according to the invention is manufactured is quite similar to a classical production process, well known to those skilled in the art. Therefore, it will not be described in detail.

In the case of a pre-recorded optical disc with a metallic substrate, a common glass/photopolymer (2P) method, for instance used for DVD-18 discs, is performed for producing the information layer and sticking it to the magnetic substrate. Said manufacturing technology, depicted in Fig. 7, comprises the steps of:

- spin-coating 70 a photopolymer UV-curing resin 13 onto said metallic substrate 10. It is to be noted that said resin 13 holds well on a metallic surface,
- subsequently, pressing 71 a polymer stamper 14 with an appropriate (inverse) groove and/or pit structure into the wet photopolymer resin 13, for instance by using vacuum-bonding or pad-bonding,
- UV-curing 72 the photopolymer resin 13 through the polymer stamper 14, which is transparent to UV-light,
- releasing 73 the polymer stamper 14 from the metal substrate after curing.

The main difference with the classical method consists of the fact that UV-curing now proceeds through the polymer stamper 14, instead of through the substrate10 onto which the photopolymer (2P) is applied.

In this way, the desired relief and/or pit structure has been replicated in the photopolymer resin 13, which forms the information layer 11. In said manufacturing process, it is important to select suitable materials for the polymer stamper 14 and the photopolymer resin 13: after UV-curing, the photopolymer resin, which is for instance an acrylic resin, should have poor adhesion to the polymer stamper, for instance a polyolefin, so that it can be released easily. In this way, good replication quality can be obtained and the polymer stamper can be re-used several times.

Once the groove structure has been replicated into the photopolymer layer, the read-only optical disc manufacturing process proceeds via the conventional route of making discs with a thin cover layer 12, like Blu-ray Discs.

In the case of a pre-recorded or read-only disc, a thin metal mirror is sputtered onto the replicated pit structure.

In the case of a rewritable (RW) optical disc, the information layer may consist of a thin film layer stack, comprising a recording material, one or more dielectric layers and a mirror layer.

In the case of a recordable (WO) optical disc, the information layer may consist of a dye layer in combination with one or more dielectric layers and/or a metal mirror layer. It could also be made of a stack of thin inorganic films similar to that of a rewritable optical disc.

With respect to the described optical disc and apparatus, modifications and improvements may be proposed without departing from the scope of the invention. The invention is thus not limited to the examples proposed. For instance, in the optical disc according to the invention, the cover layer may contain the information to be stored instead of the information layer.

The drawings and their description hereinbefore illustrate rather than limit the invention. It will be evident that there are numerous alternatives, which fall within the scope of the appended claims.

Any reference sign in a claim should not be construed as limiting the claim. Use of the verb "to comprise" and its conjugations does not exclude the presence of elements or steps other than those stated in a claim. Use of the article "a" or "an" preceding an element or step does not exclude the presence of a plurality of such elements or steps.

CLAIMS

1. An optical disc (35, 36, 37), comprising a magnetic substrate (10, 20, 30).

2. An optical disc (35, 36, 37) as claimed in claim 1, wherein said substrate is made of soft magnetic material.

3. An optical disc (35, 36, 37) as claimed in claims 1 or 2, wherein said substrate is made of metal.

4. An optical disc (35, 36) as claimed in claim 1, wherein said optical disc is planar.

5. An optical disc (36) as claimed in claim 4, wherein said magnetic substrate has a hollowed-out part for receiving a cover layer (22).

6. An optical disc (35, 37) as claimed in claim 1, wherein said magnetic substrate is planar.

7. An optical disc (37) as claimed in claim 6, wherein said substrate (30) overlaps said cover layer (32), so as to let space left for a magnet.

8. An optical disc (35, 36, 37) as claimed in one of claims 1 to 7, wherein said disc is a Small Form Factor Optical (SFFO) disc.

9. A reading and/or recording apparatus comprising rotating means (40) for rotating a turntable (50), said turntable comprising magnetic means (51) for clamping an optical disc (35, 36, 37) as claimed in claim 1 onto said turntable and heightening means (52) for preventing said disc to be in contact with said magnetic means.

10. A reading and/or recording apparatus as claimed in claim 9, comprising optical means (60) for reading and/or recording information on said optical disc (35, 36, 37), said optical means (60) being located on a same side of said optical disc than the rotating means (40).

11. An apparatus as claimed in claims 9 or 10, wherein said heightening means (52) are a circular protuberance, which is able to support the optical disc (35, 36, 37).

"OPTICAL DISC AND APPARATUS FOR PORTABLE APPLICATIONS"

Abstract

The invention relates to an optical disc (35, 36, 37) comprising a magnetic substrate (10, 20, 30) and to an optical recording and/or reproducing apparatus for recording and/or reproducing such an optical disc. By virtue of its magnetic properties, said magnetic substrate is able to clamp the optical disc onto a turntable of said recording and/or reproducing apparatus in place of a hub.

Ref: Fig. 2

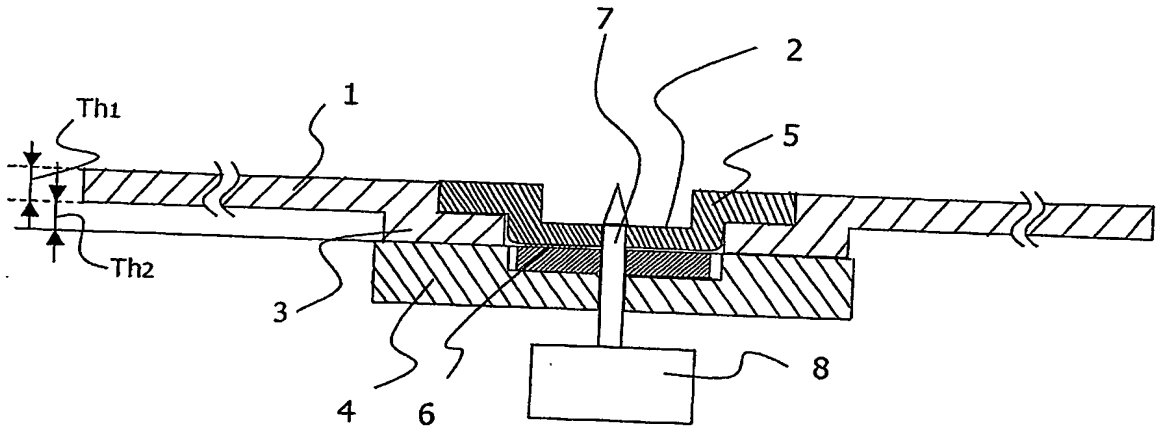

FIG. 1

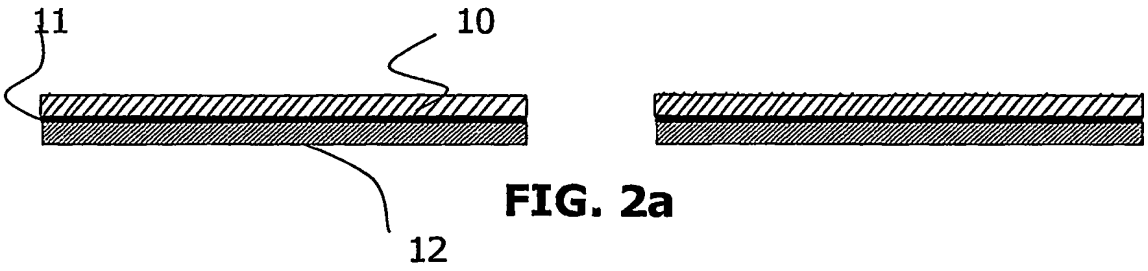

FIG. 2a

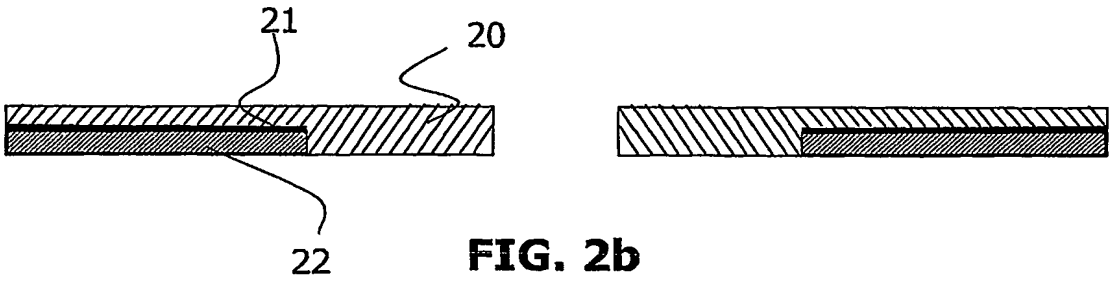

FIG. 2b

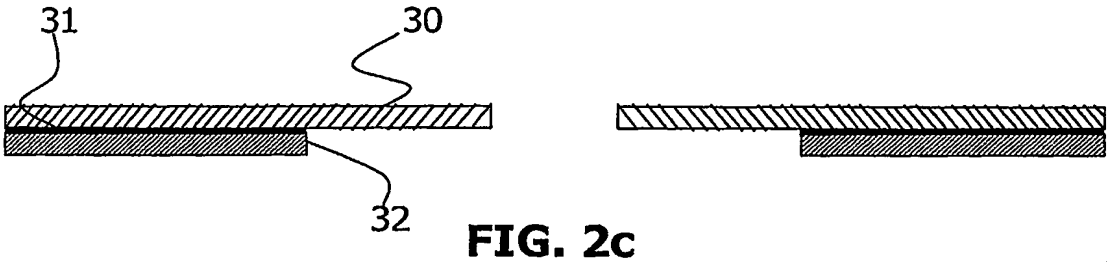

FIG. 2c

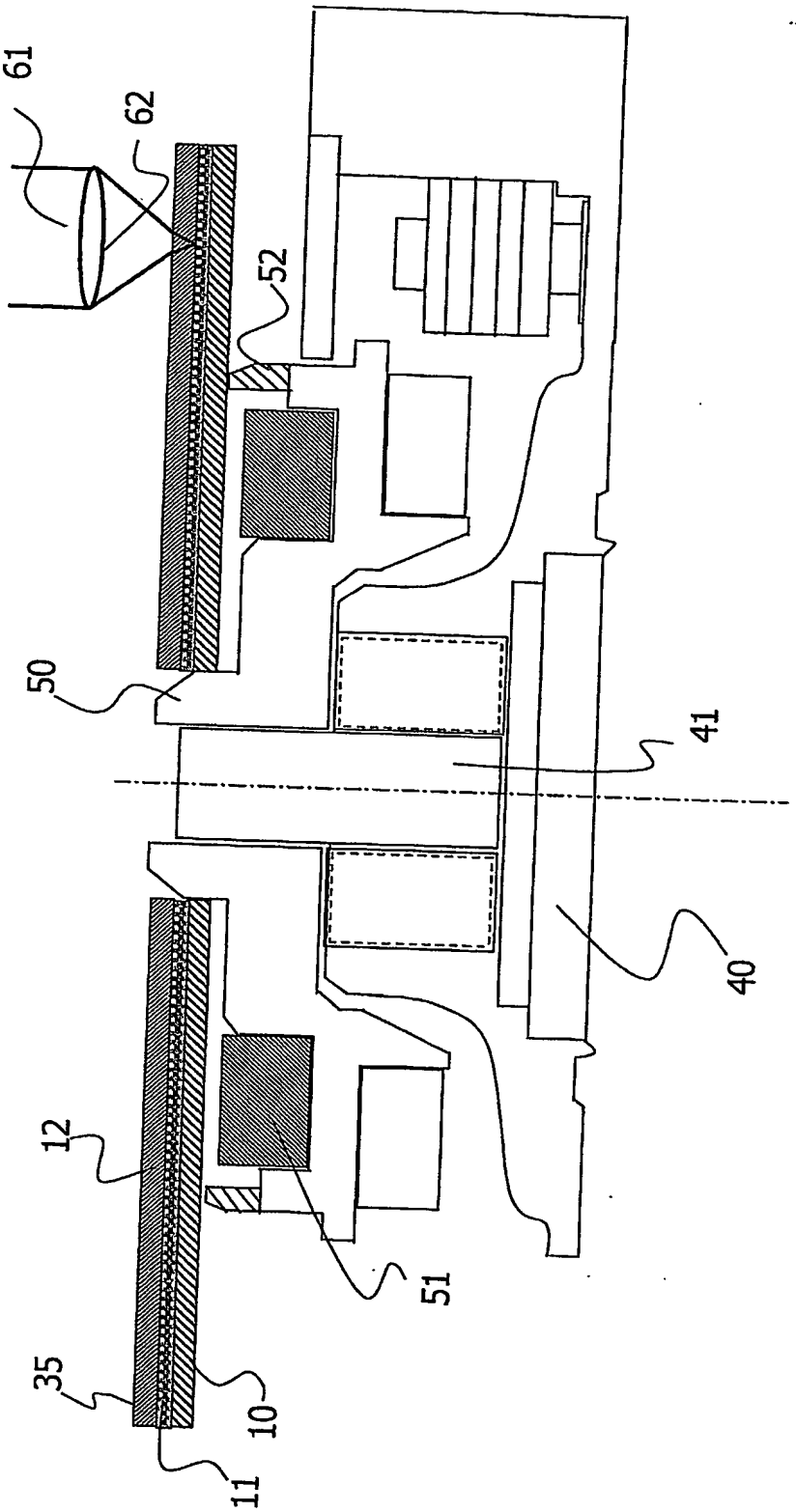

FIG. 3

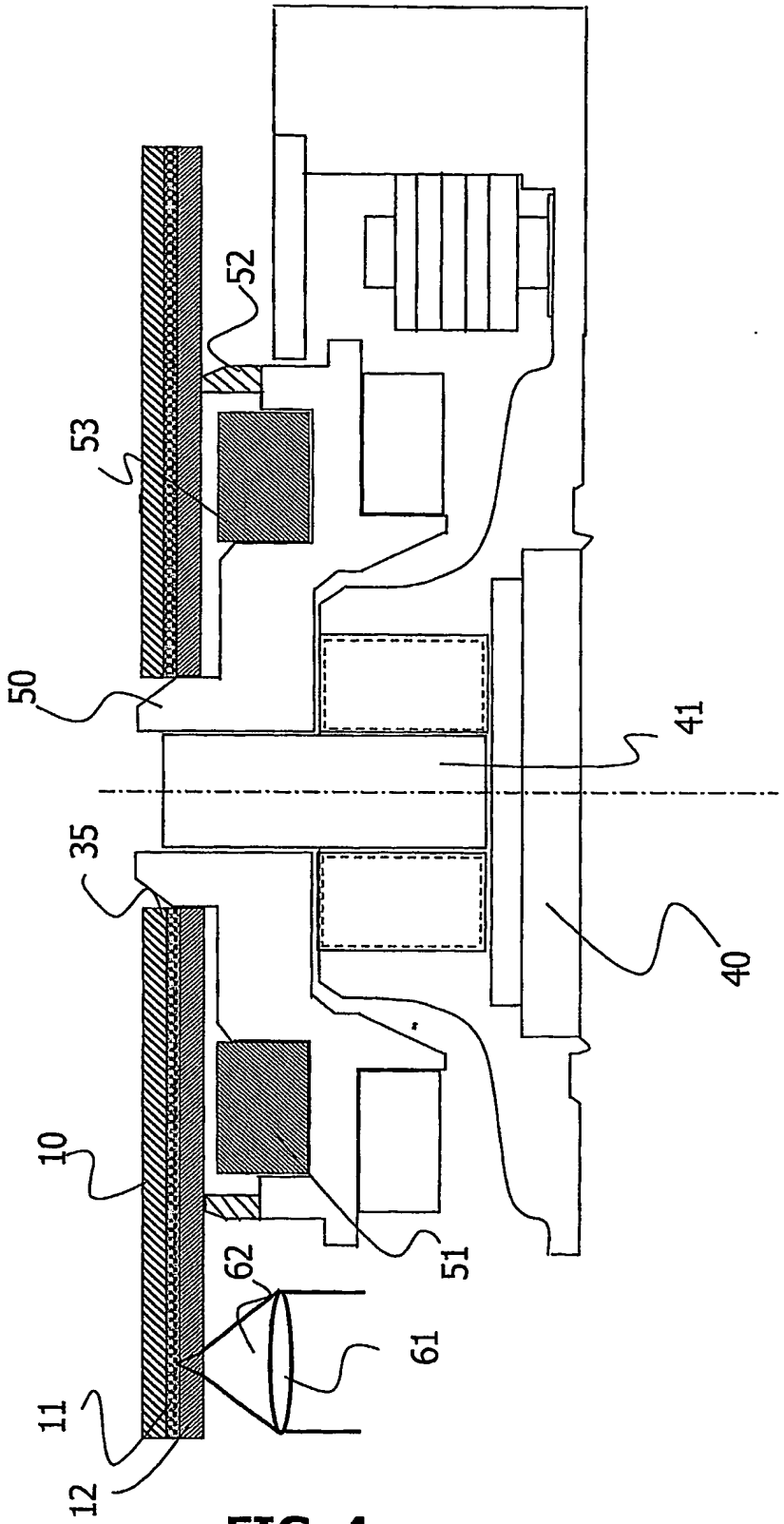

FIG. 4

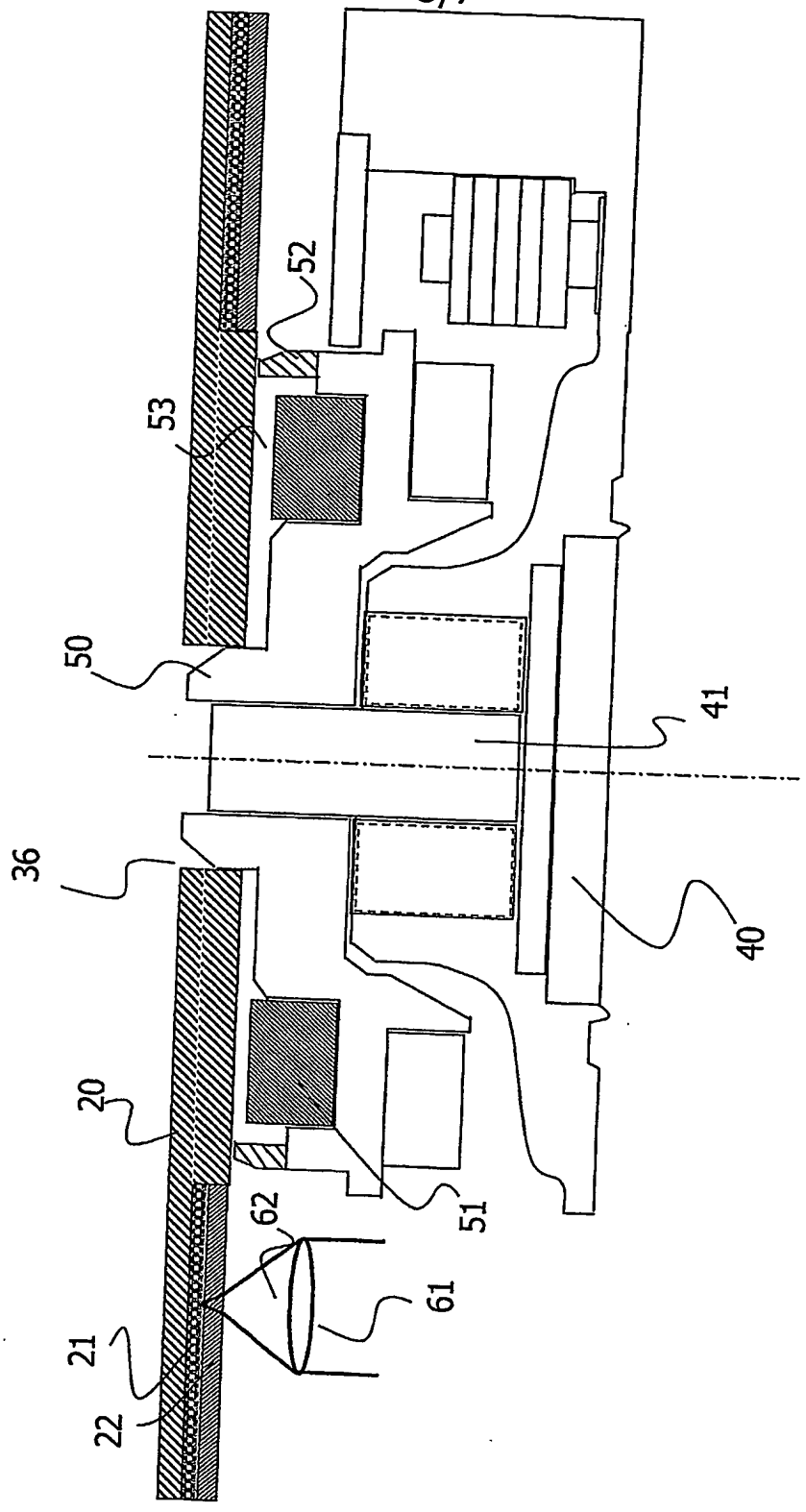

FIG. 5

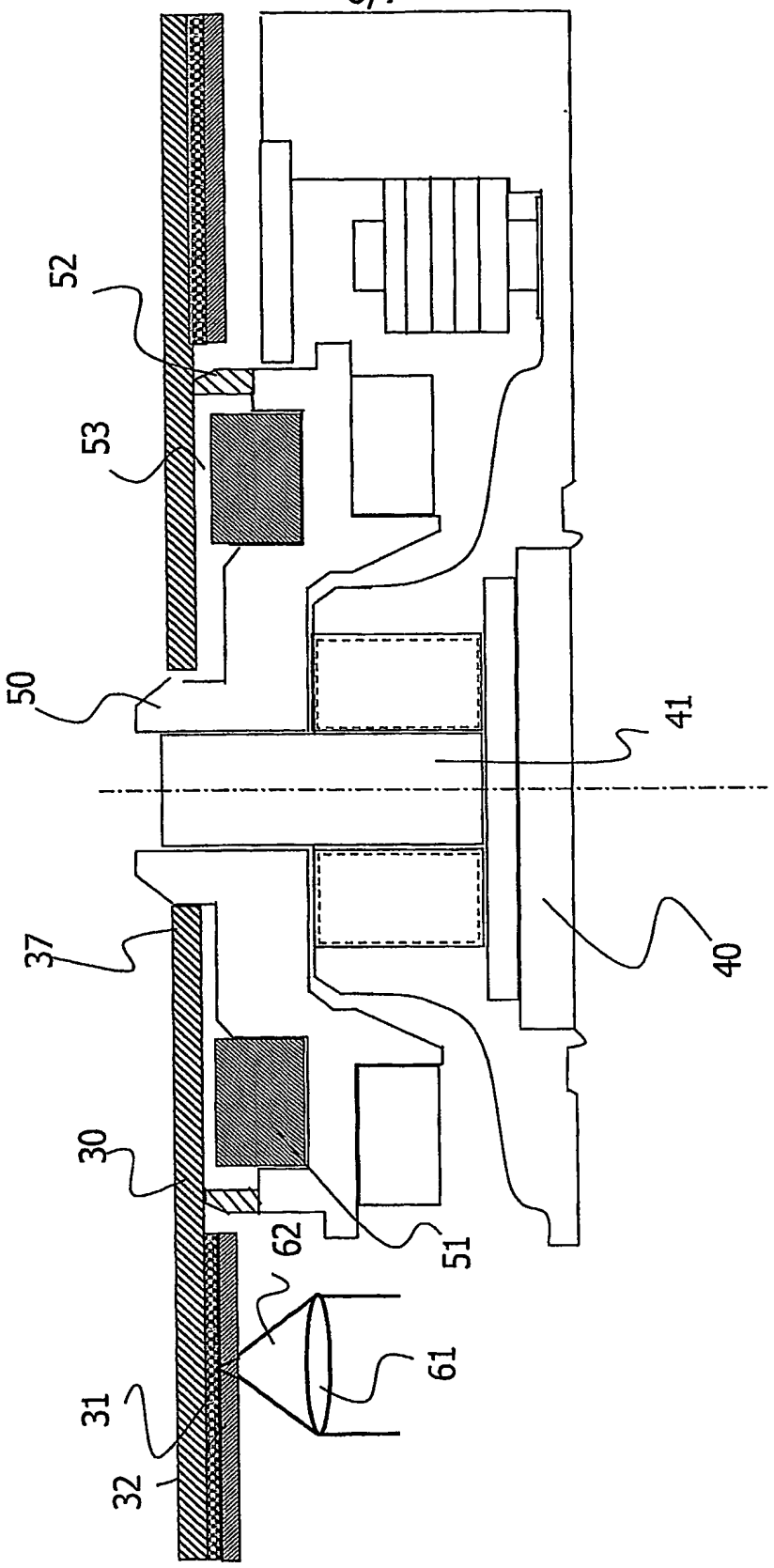

FIG. 6

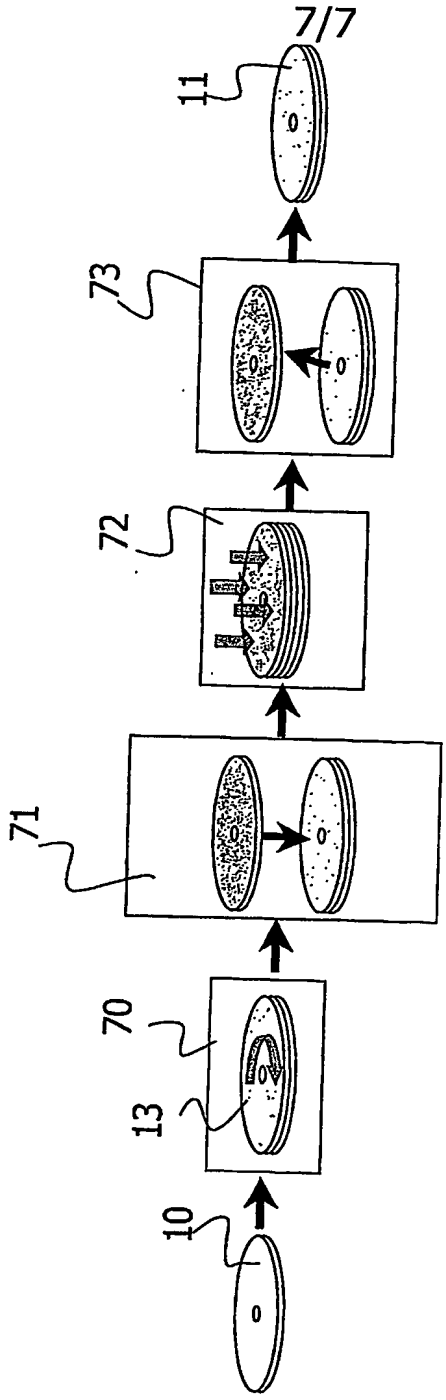

FIG. 7

PCT Application

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